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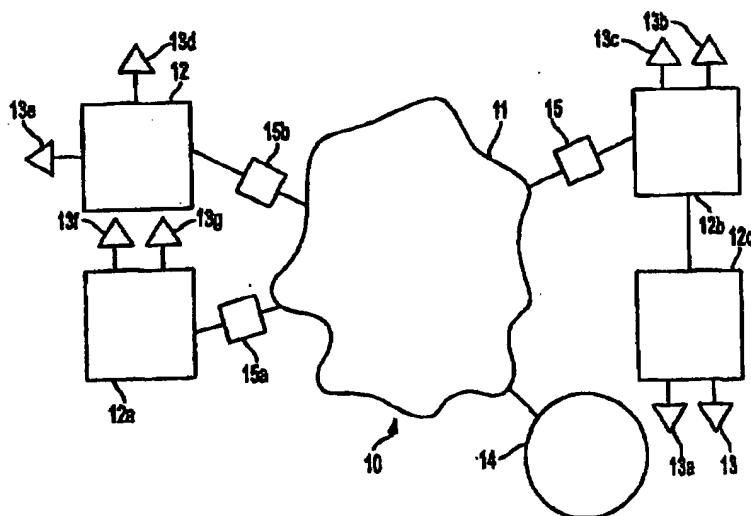
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(54) Title: COMPREHENSIVE GLOBAL INFORMATION NETWORK BROADCASTING SYSTEM AND IMPLEMENTATION THEREOF



(57) Abstract

The comprehensive global information broadcasting system and implementation thereof is designed to be used to provide a plurality of, what is commonly referred to as, Internet service providers (12) with updated information through the use of high speed satellite links (26) directly to the local Internet service provider (12) from a centralized location. The satellite broadcasting system (25) is combined with servers known as caching or proxy servers (15) located at the client site which serve to store web and other data until the end user needs to access the data and a master cache center (21) which coordinates the selection and transmission of information to those client sites via the satellite broadcasting system. The caching of data objects as close to the end user as possible will require less data to transit the backbone networks.

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COMPREHENSIVE GLOBAL INFORMATION NETWORK BROADCASTING SYSTEM AND IMPLEMENTATION THEREOF

This application is a divisional of U.S. Patent Application Serial No. 09/039,710, filed March 15, 1998, incorporated herein by reference in its
5 entirety.

TECHNICAL FIELD

This invention pertains to global information networks, currently referred to as the Internet or Internet systems, and in particular, to a system for providing a comprehensive global information network broadcasting system and
10 the methods of implementing the same using broadcast links to overcome the limitations in network distribution and caching systems inherent in conventional designs.

BACKGROUND OF THE INVENTION

The explosion of the use of Internet and other similar systems has
15 created massive performance demands on the Internet Protocol (IP) and the communication infrastructure associated with the Internet. The areas which are experiencing this communication and application explosion may include any IP network or Internet, public or private, or any group of computers connected together. The present invention has particular application in the current system
20 referred to as the Internet.

The performance demands on the network are further compounded by the inherent limitations in the IP network architecture and the popularity of certain applications on the network. Some of the most popular applications on the Internet, such as the web browser, construct, or attempt to construct, a point-
25 to-point or end-to-end connection across the network. With the Internet browser application, the Internet participant "points" the web browser to a universal resource location ("URL") address which, in turn, the browser uses to attempt to connect to the network and display the information at the URL address.

An end-to-end connection across the network makes network
30 performance parameters such as latency and network queuing delays into factors that dependent, at least in part, on each link in the point-to-point chain of

connection. Since IP also has inherent data concentration characteristics, the performance of the network may be significantly degraded by traffic concentration on the network backbones. Thus, network performance, *e.g.*, network latency, is often dominated by the latency of the most congested link. Thus, a problem in the conventional IP network is that "end-to-end" latency may be dominated by the link with the greatest congestion. Data concentration may cause a high latency on over-subscribed backbone links.

A problem related to network congestion and data concentration is the present rate of growth in the popularity of the Internet and its applications. The present rate of growth makes increases in network performance, or even maintaining network performance, simply by increasing backbone size a problematic solution, *e.g.*, at the current rate of growth in Internet usage, backbones and communication equipment may require replacement before their costs can be recovered. Thus, the conventional architecture and pricing structure for Internet service may not be self financing in some instances.

Another systemic source for network demand is the increase in the number of times that the network is being called upon to move the same data to multiple users. In practice this may be caused by the increasing popularity of particular website or the so called web portals.

The transport of redundant data problem has been addressed, in part, through the use of network caches. Network caches store data inside the network and service the user demand for data from data stored in the cache. Thus, network caches may reduce the number of identical items which are being passed end-to-end through the network by locally servicing the request for data from the local cache. The success of the network cache, however, is hampered by the fact that the ideal location, or optimal position, for the cache (or caches), is at the edge of the network infrastructure as close as possible to the end user. Thus, the optimal positioning of caches, near the edge of the network, inherently presents communication and coordination challenges.

Caching at the edges of the network, *e.g.*, using many small caches at the network edges rather than a few large central caches at the center of the

network, is further complicated by the fact that the small caches may have a limited cache community size. A limited or small cache community size means that there are few users using any one cache. A small cache community size is typically associated with a small number of request for information which makes it difficult, if not impossible, to mathematically achieve a high cache hit rate.

The cache hit rate is a mathematical term that expresses the number of hits encountered in the use of the cache per 100 requests for information. A high cache hit rate means that a high percentage of user requests are serviced by the cache. This means that the cache is working to reduce the load on the network. The cache hit rate, however, is dependent upon the number of users of the cache or members of the cache community. Thus, an engineering trade-off exists in the conventional cache design, *i.e.*, a cache is more useful at improving latency at the edge of a network but the cache will, on average, have a lower hit rate because of the small cache community size.

Another problem in the conventional network is the level of general broadcasting that can be accomplished within the conventional architecture. As the Internet was established, the vast majority of network traffic was point to point in nature. In the present network, however, broadcast data on the network has surpassed other forms of traffic in terms of volume, but the network continues to have a point to point architecture which does not provide the physical medium or logical structure to implement broadcast within the network. The result is that the Internet is choking itself with replicated data, moving thousands of copies of the same data around at any given moment in time. The major difference now and when the network originated is the increased size of the transmission lines and switch capacity which are able to move more data. The IP network, however, is still using the same basic architecture as was found in the original system.

Another factor that effects network performance is that most of the data on the Internet is accessed infrequently. A small proportion of the data available on the Internet is receiving the majority of the inquiries or "hits" on the system.

There have been a number of attempts to improve network performance. One way of approaching the problem is by employing larger capacity storage equipment and/or faster communication equipment. This may provide faster network response time and/or ameliorate network congestion and delays in the short term. Indeed, the continuing availability of larger capacity and lower cost storage technology have made this a cost effective short term, however, stop gap, approach to network congestion. As discussed above, the rate of growth in the Internet's popularity may require equipment replacement before equipment costs can be recovered. Also, a number of United States Patents describe attempts to improve speed and storage capacity of interactive networks through a number of different methods - those patents include No. 5,442,771 issued to Robert Filepp *et al.* for a "Method For Storing Data In A Interactive Computer Network" and the patent issued to Ashar Aziz, No. 5,588,060 for a "Method And Apparatus For A Key Management Scheme For Internet Protocols."

SUMMARY OF THE INVENTION

It is the goal of the present invention to address these short falls and problem areas to improve performance of the Internet. Thus, a first object of the present invention is to achieve real improvement in the performance over conventional caching system design through the use of a novel and nonobvious scheme to increase the local cache hit rates by employing methods and apparatus to improve the selection of data for storage in a local cache.

Another object of the present invention is a way to mesh a broadcast architecture into the point-to-point architecture of the Internet to enable the network to achieve the advantages of a broadcast architecture while maintaining the benefits of a point-to-point network.

Another object of the present invention is to combine the methods and apparatus for improved cache performance with the methods and apparatus used to mesh a broadcast architecture onto the point-to-point network architecture to achieve a complementary result.

Another object of the present invention is to extrapolate global demand for information into a tangible and practical solution to select data for storage

into local cache devices thereby improving cache performance for caches with a small cache community size.

Another object of the present invention is the extrapolation of a statistically relevant sample from a list of requests for information that may

5 modify a threshold of interest parameter for the selection of information into a local cache.

Another object of the present invention is to modify a threshold of interest in the selection of data of interest for input into a local cache based at least in part on historical interest in local demand for said data over a
10 predetermined window of time.

Another object of the present invention is the employment of a proactive way to select data for input into a local cache in anticipation of network demand for said data of interest.

Another object of the present invention is the directed selection of
15 information into particular local cache to achieve improvements in local cache performance.

Yet another object of the present invention is the deployment of a fee based broadcast service that improves local cache performance which in turn allows Internet service providers to achieve a greater return on investment in
20 communication equipment and frees up network capacity to add additional Internet subscribers.

These and other objects of the present invention, as discussed in detail below, will become apparent to those skilled in the relevant art upon disclosure of the inventions and teachings contained herein.

25 A way to improve the Internet's performance is to improve the cache hit rate for at least some of the caches in the network. When a cache services the user's request for information, the network conserves capacity because an end-to-end connection is not required to service the request. A novel way to improve the selection of data for storage in a local cache is to determine the
30 interest in the data on the network as a whole or as a sample determining the popularity as a whole. This may be accomplished by a system that measures the

number of access requests for information and the type of information that were not available on the local caches. These can be called local cache miss information. The system may then examine the local cache miss information from some or all of the local sites and determine what information is of global
5 interest to the Internet community. The system may then determine by a variety of ways discussed further below what information is a good selection for storage into local caches. Thus, the system provides a way to determine the selection of information for storage into a local cache from a pool of local cache miss information.

10 A second element that may improve the operation of the Internet is a broadcast system which takes the information or data that has been determined to be of sufficient interest that it is useful to input into local caches and broadcast that information and data to the local cache systems. This action may relieve the network from the identified problem of transporting replicated data
15 and redundant information across network backbones. This high speed cache update or broadcast channel provides the network with fast relief from redundant data transport and will quickly reduce congestion across the entire Internet system.

The two methodologies of local cache sampling and broadcast cache
20 updates complement and provide a synergistic solution to each others individual weaknesses thereby allowing the two technologies to blend into a single unique solution to the problems described herein. For the problem of multiple identical data elements traversing the Internet, caching represents a good solution but because of the tradeoff issue of small cache community sizes not providing high
25 hit rates and the optimal positioning of the cache, caching is limited in its practical application. Satellite one-way broadcasting addresses this problem by, when combined with the data evaluation and selection that is described herein, aggregating cache community elements from all cache clients into one single cache community and thus allowing high hit rates to be achieved.

30 The use of satellite communications to provide a broadcast medium to the Internet may be accomplished by orbital satellites which allow a single

signal to be sent up to a satellite and the resulting signal to be sent down to large geographic areas. A conventional satellite broadcast, however, settles from the fact that all users may not want to use the broadcast information at exactly the same time. The store and forward capability of a caches such that it accepts
5 information and then store it for a time so that it can be used at times other than the exact time that it is broadcast, solves the major difficulty with satellite one-way broadcast.

This invention, *inter alia*, teaches a method for combining the capabilities of satellite communications and caching servers to overcome the
10 disadvantages of each and, at the same time, improve the levels of hit rate that may be achieved by caching servers thereby saving bandwidth and other valuable resources within the Internet and other data networks which can use these technologies. This invention, *inter alia*, further teaches how to construct a selection system which uses one-way satellite communications in order to build
15 a true broadcast capability as an addition to the existing point to point Internet network, and to use this broadcast capability to aggregate the cache community size, thus increasing the hit rates of caches on all caches which subscribe to the service without regard to a number of members of the individual cache server cache community size.

20 Thus, the present invention provides a complete comprehensive Internet broadcasting system that employs a caching system that is positioned close to the end user while still being part of the shared infrastructure and achieving a high cache hit rate. The system further provides a complete comprehensive Internet broadcasting system which seamlessly overlays a capability on the
25 existing Internet that may allow a real broadcast so that the data or information can be transmitted once and received at the local caching systems.

This hybrid broadcast/cache architecture is very adaptable. Furthermore, the system is easy to install and readily available to all customers and Internet service providers. The system works with conventional cache systems, such as
30 those available from Inktomi, Inc. and with conventional commercial satellite services such as GTE Spacenet or Hughes Satellite Systems.

Particularly, this invention, *inter alia*, teaches a method for implementing a comprehensive global information network broadcasting system, for use in overcoming inherent limitations in current global information network systems including the requirement for multiple copies of the same information or data being moved around the Internet to serve individual users along with the point to point nature of the infrastructure, comprising the steps of providing a master caching center for receiving information requests and sending out information and data; installing local caching systems for Internet service providers and customers sites; providing a satellite broadcast linking system to the local caching system for providing nearly instantaneous information from the master caching center to the local caching systems; disseminating a program for selecting data elements for storage in the local caching systems; and distributing data and information updates for the local caching systems as predetermined by the master caching center.

This invention, *inter alia*, also teaches a method of operating a comprehensive global information network broadcasting system, for use in overcoming inherent limitations in current global information network systems including the requirement for multiple copies of the same information or data being moved around the Internet to serve individual users along with the point to point nature of the infrastructure, comprising the steps of receiving a request for information or data from a customer to the local cache site; determining the location of the requested information or data among a number of location sources; notifying the master cache center of the lack of success in finding the requested data or information in the local cache system; analyzing the number of requests that the master cache center has received on a particular piece of information or data; retrieving the data or information from the Internet once the level of interest has been achieved; and sending the requested information or data through the satellite broadcasting system to all local cache sites once the data or information requests have reached a predetermined level.

This invention, *inter alia*, further teaches a comprehensive global information network broadcasting system, for use in overcoming inherent

limitations in current global information network systems including the requirement for multiple copies of the same information or data being moved around the Internet to serve individual users along with the point to point nature of the infrastructure, comprising a master caching center for receiving
5 information requests and sending out information and data; local cache systems positioned at customer and Internet service provider sites for sending out information and data requests and receiving and storing the information requested; means for connecting said master caching center with said local
10 cache systems; and means for determining the level and interest in a particular piece of information or data and allowing the information and data to be sent from the master caching center to the local cache systems.

DESCRIPTION OF THE FIGURES

Further objects and features of this invention will become ore apparent by reference to the following description taken in conjunction with the
15 following figures, in which:

Figure 1 is a system diagram for the current Internet system;

Figure 2 is a system diagram for the novel comprehensive global information network broadcasting system;

Figure 3 is a block diagram of a method of implementing a
20 comprehensive global information network broadcasting system; and

Figure 4 is a block diagram of a method of operating a comprehensive global information network broadcasting system.

Figure 5 is a representative block diagram of the cache update procedures.

DESCRIPTION OF THE PREFERRED EMBODIMENT

25 As shown in the figures, the conventional Internet system 10 (shown in Figure 1) may be composed of an Internet highway 11 having a number of clients or Internet participants 12, 12a, 12b and 12c. The clients can be an Internet service providers or corporate customers and each one of these
30 customers can have a large number of their own clients or internet participants shown as 13 through 13h. In a typical Internet application, a participant, for

example participant 13, may request information from an information source 14. This request for information may originate at an application such as a web browser at the participant's 13 equipment. A URL request from the web browser may be output from the participant 13 and input into the participant
5 Internet service provider 12c. The Internet service provider may then pass the request to another Internet service provider 12b. This Internet service provider 12b may pass the request through cache 15 to the Internet highway 11. The Internet highway 11 may then pass the URL request to the information source 14. The information source 14 may then formulate a response to the URL
10 request from the participant 13 and send the response back over the network 11 through cache 15, through Internet service provider 12b, through Internet service provider 12c and to the user or participant requesting the information 13. In the conventional network, this end-to-end transmission of URL and URL response may be reported for each and every participant on the network. Thus,
15 information from information source 14 may be redundantly transported to each participant.

If caches are activated and employed on the network 15, 15a and 15b, they may reduce the information flow across the network 11. In a simple illustrative example, internet participant 13 may request information from
20 information source 14 as described above. Active cache 15 may store the information response from the information source 14 locally at the cache 15. When internet participant 13a, for example, requests the same information from information source 14, the request for information may be satisfied by the information stored in the cache 15. Thus, the request for information from the
25 second participant 13a may be terminated and satisfied at cache 15, thereby reducing traffic across the network 11.

If caches 15 through 15b are located at positions around the net it may reduce the number of messages sent across the network. A problem, however, occurs in small systems, because caches in these small systems have very few
30 (relatively) information requests. In order to work efficiently, cache's need to have cache community size large enough to have a substantial hit rate. The

costs associated with conventional cache equipment prohibits cost effective implementation in small cache community applications. Another difficulty of the conventional system design is the network infrastructure. Given the fact that the information has to travel over point-to-point links, the only other way of speeding up the service, is to widen the lines or bandwidth. This solution, although feasible, has a finite limit and diminishing returns.

An embodiment of the comprehensive Internet broadcasting system 20 is shown in Figure 2. The system may be comprised of a master cache center 21 that is operationally connected to the Internet 22 and a satellite uplink transmitter 23 that may, in turn, uplink data to a geosynchronous satellite 24. Typically, four geosynchronous satellites are employed to effect planetary coverage low and near earth orbiting satellites, however, are within the scope of the present invention. The uplink transmitter 23 may be duplicated for each of the geosynchronous satellites employed for coverage. Thus, a land line, not shown, may transport the present data to a remote uplink site to provide access to other satellite regions.

The system may have a plurality of clients comprising Internet service providers or customers. Each of the clients may have a local cache system 25 through 25c which may be comprised of a satellite broadcast receiving system 26 through 26c, a cache adapter 27 through 27c and a cache 28 through 28c. The cache 28 through 28c may have a cache disk or cache storage device 29 through 29c for the storing of information and data received from the Internet or the broadcast system.

The system of the present invention may also be employed over high speed land lines and wireless terrestrial links. The system may maintain the advantages of a point-to-multipoint configuration through the use of high speed half duplex or asymmetric communication equipment. The system may also benefit from direct connection into the high speed links available from network switches operators such as the SONET and/or DS-3 connections. Thus, it is within the scope of the present invention to establish the high speed connection

from the master cache to local caches through terrestrial communication methods.

By way of illustrative example, the improved system may function by a customer 31 of the Internet service provider sending a message or a URL request to the local Internet service provider's cache system 25 requesting information or data. The Internet service provider's cache 28 may determine whether it has the current version of the information or data stored on its cache. The cache 28 may then check whether the information or data is located in the cache adapter 27. The cache adapter in this illustrative example, does not have the material because it does not yet store the information. The cache adapter 27 responds negatively to the request notifying the cache 28 to search elsewhere. The local cache 28 may then search other caches or the Internet for the requested information. The cache adapter 27 may send a message over the Internet to the master caching center 21 reporting the "miss" of the requested information. The master cache 21 may then record the information regarding the cache miss and measure the amount of interest in the information or data from the local caching systems 25 through 25c. The master cache 21 may employ a variety of methods described further below to determine at what point the level of interest is sufficient to broadcast the information or data to the Internet service providers caches.

The master cache 21 may obtain the requested information or data from a source 30 via the Internet 22. The master cache 21 may then compress the information for storage or transmission. The master cache 21 may assign a priority to the information based upon the levels of interest and a predetermined transmission formula as described below. The information or data may be broadcast to the satellite 24 which may, in turn, broadcast to the satellite receivers 26 through 26c of the Internet service providers or customers. After the information is received by the satellite receiver 26, it may be passed to the cache adapters 27 through 27c. The cache adapters 27 through 27c may then formulate a user request for the data for the local cache 28 through 28c to find the information. This action may cause the local cache 28 through 28c to search

for the data. This time, the local cache may find the information or data at the cache adapter 27 through 27c. The local cache 28 through 28c may then transfer and store the information on the cache storage disk or storage device 29 through 29c. In another interface made of the invention, the cache adapter 27 may
5 directly transfer information to the cache file system.

Referring now to Figure 3, the novel method for implementing a complete comprehensive Internet broadcasting system 40 may be comprised of the following steps: providing a master cache center for receiving information requests and sending out information and data 41; installing local caching
10 systems for Internet service provider and customers sites 42; providing a satellite or wideband broadcast linking system for connecting the local caching systems in order to provide nearly instantaneous information and data from the master cache center to the local caching systems 43; disseminating a program for selecting data elements for storage in the local caching systems 44; and
15 distributing data and information updates for the local caching systems as predetermined by the master caching center 45.

Referring now to Figure 4, a novel method of operating a complete comprehensive Internet broadcasting system 50 may employ the following steps in its process: receiving a request for information and data from a customer to
20 the local cache site 51; determining the location by the local cache site of the requested information or data from a number of locations sources 52; notifying the master cache center of the lack of success in finding the requested data or information in the local cache 53; analyzing the number of requests that the master cache has received for a particular piece of information or data 54;
25 retrieving the data or information from the Internet 55; and sending the requested information or data through the satellite broadcasting system to all the local cache sites once the data or information requested has reached a predetermined level 56.

Figure 5 depicts a representative block diagram of the procedures and
30 methods that may be used to determine cache update priority. The procedure may receive cache miss information from the network cache adapters 100. It is

understood that cache adapters 27 may be deployed as part of a subscription service to the cache update broadcast of the present invention. Each site, however, is not required to have a cache adapter that reports to the master cache. So long as enough cache adapters are deployed and reporting cache miss
5 information to the master cache to provide a statistically relevant sample of Internet participant demand for Internet information, or through some other feedback methodology, it is within the scope of the present invention. .

Once the system receives the cache miss information 100 the system may store the miss information in a volatile or non-volatile storage device 104.
10 This may provide a non-volatile storage record for the threshold calculations described below.

The first threshold of interest factor that may be employed by the present invention is determining whether requests for information exceed a predetermined rate 106. The rate of request for information can be determined
15 by collecting information as to the time at which the request for information was received by the system. When the rate of requests for information exceeds a predetermined number over a predetermined time, for example 10 minutes, the system may designate the information for broadcast 120. If the rate of the requests for information does not exceed the predetermined threshold, the
20 system may pass the request for information to the next rule 114.

The next rule the system may use to determine whether to broadcast the information to the subscriber caches is to determine whether the request for information exceeds a global demand threshold 108. In this rule, the system may determine whether the request for information exceeds a predetermined
25 number for overall demand. This parameter may identify web pages that provide a consistent long term level of interest. If the request for information exceeds this threshold, then the information is designated for broadcast to the subscriber caches 122. If the request for information does not exceed this predetermined threshold then the system may pass the request for information to
30 the next rule.

The next rule determines whether to designate the information for broadcast to a local cache based on localized demand for the information. It is within the scope of the present invention to store cache miss information that identifies which subscriber cache is reporting the cache miss information. The system may then use a predetermined threshold for localized demand. For example, from the rules described above, which are herein incorporated by reference, to designate whether the information should be broadcast to a local subscriber cache 124. Thus, it is within the scope of the present invention to update a local subscriber cache by uniquely addressing a local cache adapter for the broadcast cache update. In a first unique addressing mode, a conventional satellite receiver may be addressed to receive a unique satellite broadcast. In a second unique addressing mode, the present invention may address the cache adapter through conventional protocol addressing techniques. If the local information threshold rule 110 is not exceeded, then the system may pass the information request to the next exemplary rule 118.

The next exemplary rule 112 may determine whether the request for information is subject to a heuristic override 112. The heuristic override rule may determine whether a system operator has manually designated information for broadcast. If the information has been designated for broadcast, the system will schedule the information for broadcast 128. If the information has not been designated for broadcast, the system may procedure terminate and return 132. the system may execute an override rule that does not pertain to the request for information passed via the other rules. It is understood that the system override rule may immediately schedule information for broadcast to the local subscriber caches.

The system may employ a priority scheme to broadcast cache update data 140. The priority scheme may use a first in first out rule or a weighted priority scheme to allow higher priority updates such as information designated from 120, which may designate a rapid increase in demand, for broadcast to the subscriber caches.

The above described methods and technologies improve the operation of the Internet by increasing the hit rate of the local cache sites by combining them into a single cache community which can then aggregate its usage and significantly improve the hit rates to the benefit of the Internet service provider or end user organization. The elements designed into the system that result in the improvements include the use of a cache adapter at each of the local cache sites. This adapter is informed when the local cache site has been asked for information or data and is also informed that the local cache site did not have the information and data. This is important because if a local cache site doesn't have the information or data, it requires the local cache sites to seek the information in the Internet and then to place that information in the local cache site.

The adapter communicates the miss information with the master cache center. The master cache center analyzes the miss data from all the local cache sites and determines the information and data that are of a sufficient interest to the Internet community, using the companion software program described below to do so. This determines the information and data that warrants having the information and data sent by means of the satellite connection and thus being placed in all of the local cache sites in the system.

Controlling the amount of information and data being sent to the local caching sites may be useful because of the nature of the information and data being delivered. Much, if not a majority of the information and data available on the Internet may be considered archival or data which is accessed so seldom as to make it not desirable to have cached in multiple locations. Active material are items that have a regular level of interest and is of some benefit to have some degree of local site caching. Popular material which is accessed regularly is worth caching. Intensive (frequently updated) material is of questionable value caching because it is changed so often. The factor that is under the control of the software program described below is that the material being sent to the local caching sites should provide value to the Internet service providers or end user.

A number of processes can be used to improve the system. This could include having the master cache center pre-stage information or data that has been requested. This process allows the master cache server to obtain the information or data even before the evaluation has been done to determine whether it will be sent up to the satellite. This will minimize the time delay experienced once the determination has been made that the information or data meets the criteria to be transmitted to all local caching sites. The system would also use a predictive model to position large information items that do not change frequently and have regular levels of interest.

CLAIMS

While I have described my invention in connection with specific embodiments thereof, it is clearly to be understood that this is done only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the appended claims.

1. A method for reducing network congestion through a direct broadband network architecture that overlays a point-to-point internet architecture comprising:

receiving a URL request from a network participant at an internet service provider;

determining whether a response to said URL request can be generated from a local cache at said internet service provider;

directing information about said URL request to a master cache when said response to said URL request could not be generated from said local cache;

and

receiving information for storage at said local cache from a master cache, said information for storage selected by said master cache.

2. The method of claim 1 further comprising:

a broadband connection between said master cache and said local cache, said broadband connection transporting at least said information for storage in said local cache from said master cache.

3. The method of claim 2 further comprising:

a point-to-multipoint broadband channel between said master cache and said local cache, said point-to-multipoint channel connecting at least one more local cache to said master cache, said point-to-multipoint broadband channel transporting at least said information for storage in said local cache from said master cache.

4. The method of claim 2 wherein said broadband connection is via a satellite communication link.

5. The method of claim 3 wherein said point-to-multipoint broadband channel is a satellite communication link.

6. The method of claim 1 further comprising:
receiving communication via a cache adapter operationally connected to said local cache, said cache adapter receiving information from said master cache for storage in said local cache.

7. The method of claim 1 further comprising:
transmitting said URL request to the internet from said internet service provider if said URL request is not satisfied with information from said local cache.
- 5 8. A method for reducing network traffic through a master cache directing the content of a plurality of local caches comprising:
receiving information about a cache miss from a local cache at a master cache;
retrieving information from a URL identified in said cache miss
10 information;
storing said retrieved information in said master cache; and
transmitting said retrieved information from said master cache to at least one local cache.
9. The method of claim 8 further comprising:
15 transmitting said retrieved information from said master cache to said local cache via a direct communication link.
10. The method of claim 9 wherein:
said direct communication link is a high speed communication link that is external to the communication path through which said master cache retrieved
20 information from said URL identified in said cache miss information.
11. The method of claim 9 wherein said direct communication link is via a satellite link.
12. The method of claim 8 further comprising:
transmitting said retrieved information from said master cache to said
25 local cache via a satellite communication link, said satellite communication link providing access to a plurality of local caches that are programmed with information, at least in part, from said master cache.
13. A system for easing network congestion on the internet comprising:
a plurality of local caches operationally connected to internet
30 participants at a plurality of local hubs;

a plurality of network adapters, at least one said network adapter operationally connected to at least one of said plurality of local caches, each said network adapter for receiving data for storage in said cache;

5 a master cache in communication with said plurality of local caches, said master cache receiving information about requests for information from said internet participants that are not satisfied by data in at least one local cache, said master cache sending said information requested by said internet participant to each of said plurality of caches.

14. The system of claim 13 further comprising:

10 a high speed data connection operationally linking said master cache with said plurality of local caches, said high speed data connection for transporting said information requested by said internet participant from said master cache to said plurality of caches.

15. The system of claim 14 further comprising:

15 said high speed data connection operationally linking said master cache with said plurality of local caches is a point-to-multipoint broadcast connection.

16. The system of claim 15 where said point-to-multipoint broadcast connection is a satellite based communication link.

17. The system of claim 13 wherein said master cache selects whether to
20 propagate said information requested by said internet participant to said plurality of local caches.

18. The system of claim 17 further comprising:

a predetermined criteria employed at said master cache to select whether
to propagate said information requested by said internet participant to said
25 plurality of local caches, said predetermined criteria determining network demand for said information requested by said internet participant.

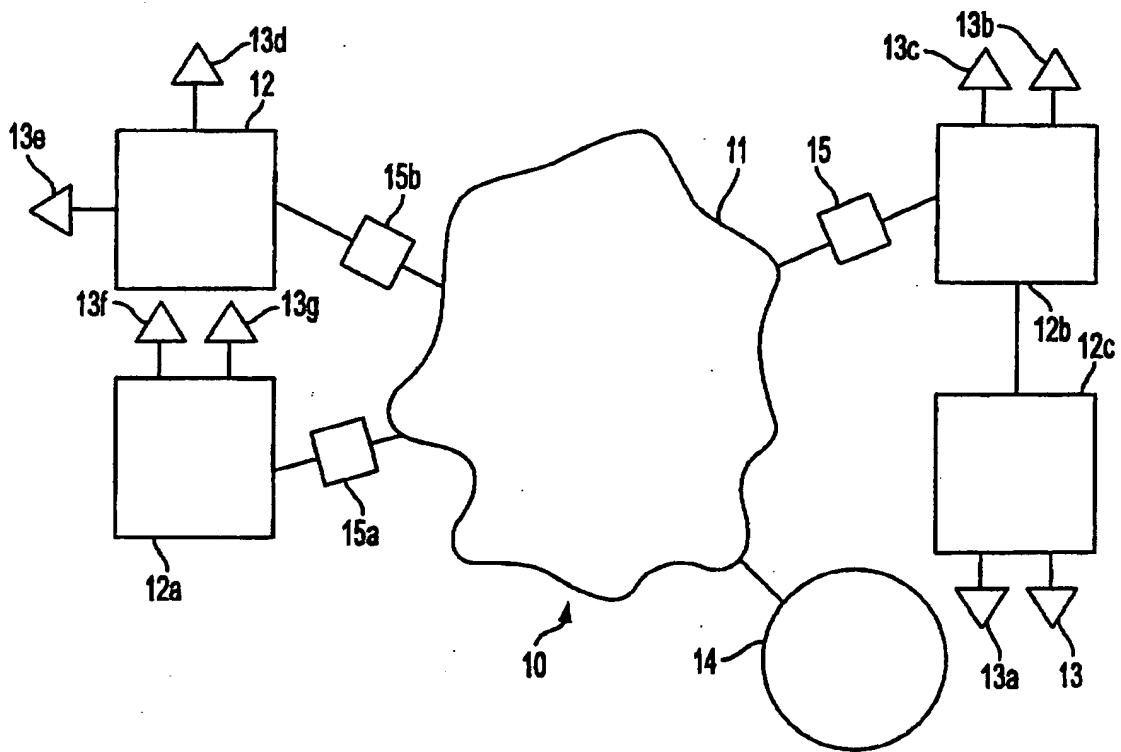


FIG. 1

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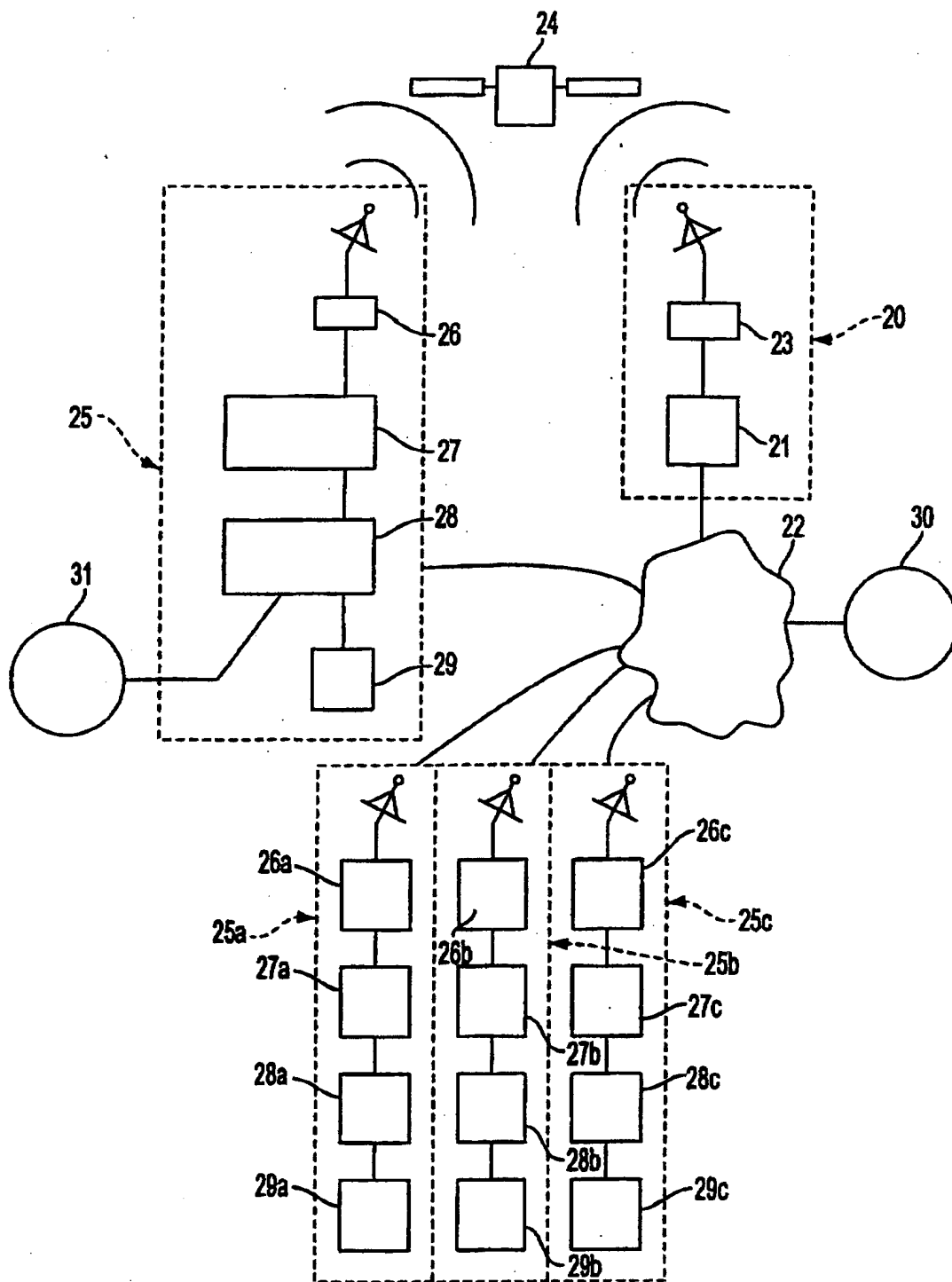


FIG. 2

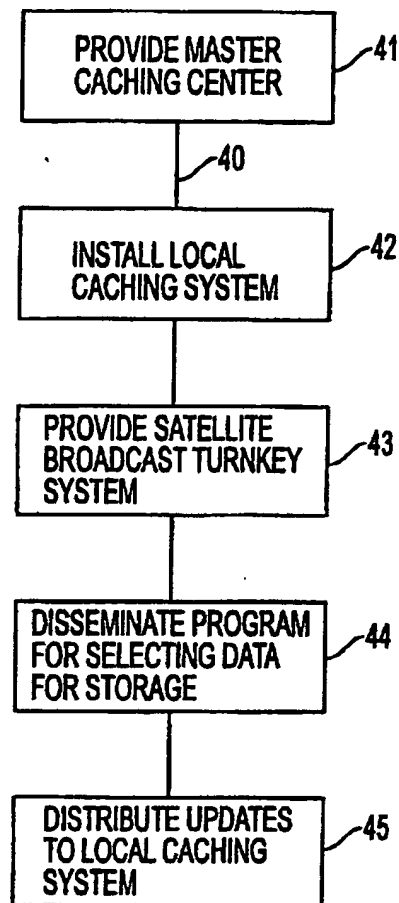


FIG. 3

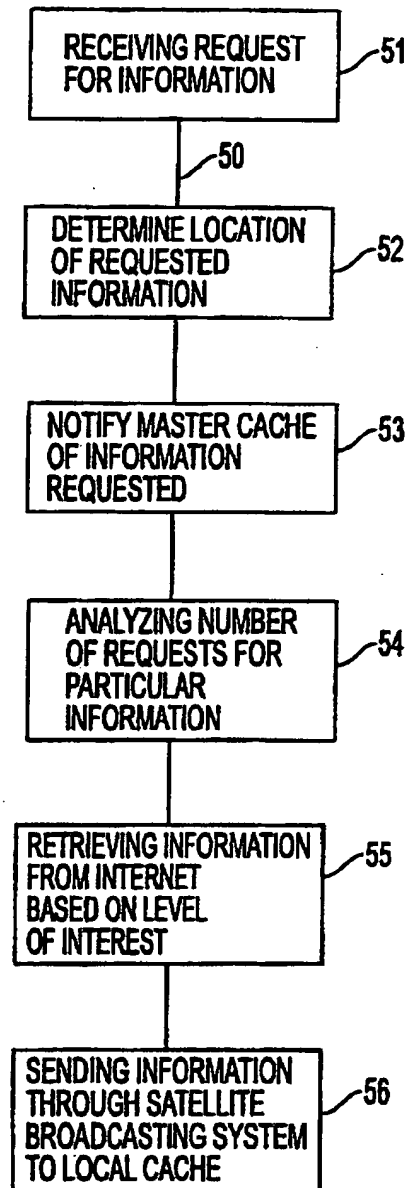


FIG. 4

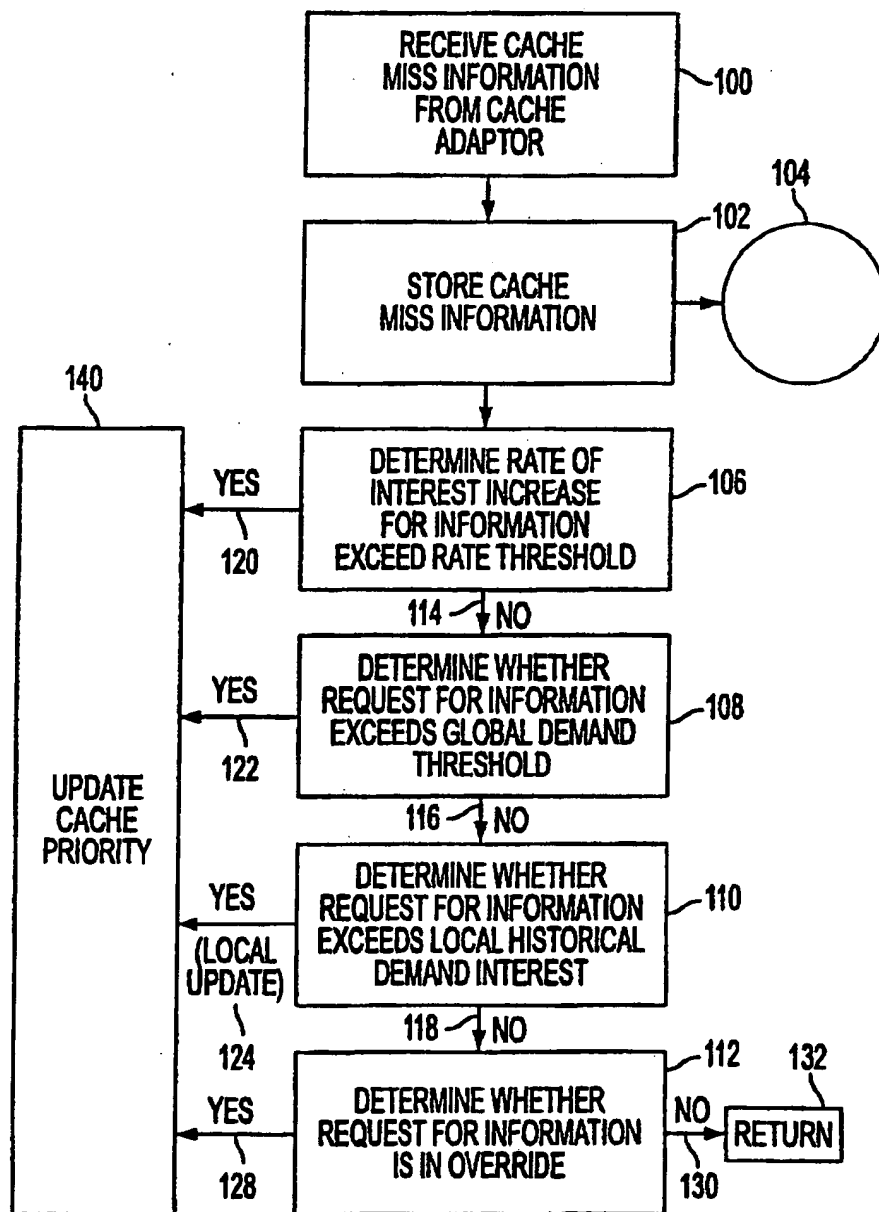


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US99/05649

A. CLASSIFICATION OF SUBJECT MATTER

IPC(6) : G06F 13/00

US CL : 709/203

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 709/200,202,203,212,213,214,219; 711/113,118,119,124,133,141

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS search terms: local cache, master cache, internet, proxy, client, server, satellite

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5,623,656 A (LYONS) 22 April 1997, Abstract, figures 1 and 2, col. 1 (line 10-et seq.).	1-18
A	US 5,548,724 A (AKIZAWA et al.) 20 August 1996, Abstract, figure 1, col. 1 (line 1-et seq.).	1-18
A	US 5,434,994 A (SHAHEEN et al.) 18 July 1995, Abstract, figure 1, col 1 (line 1-et seq.).	1-18
A	US 5,442,771 A (FILEPP et al.) 15 August 1995, Abstract, figure 2, col. 1 (line 1-et seq.).	1-18

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:	*T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
A document defining the general state of the art which is not considered to be of particular relevance	*X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
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L document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	*A* document member of the same patent family
O document referring to an oral disclosure, use, exhibition or other means	
P document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 30 APRIL 1999	Date of mailing of the international search report 27 MAY 1999
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer ROBERT B. HARRELL <i>James R. Matthews</i> Telephone No. (703) 305-9692

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